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THE PERUVIAN FISHERIES*

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MAN'S quest for food and more food to feed an ever increasing population has brought a large part of the arable lands of the world under cultivation. Forests have been leveled, swamps drained, and deserts irrigated. Experiments are even being made in soilless agriculture. Concurrently, fishing frontiers have been pushed farther and farther out to sea and along the coast lines of the world. Now many species of fish are pursued over thousands of miles of ocean—throughout their range of distribution, in fact. In expanding these frontiers, species new to the commercial world have been found in abundance and exploited.

For several centuries after the Renaissance, fishing and farming advanced at more or less comparable rates. When the Hanseatic League was flourishing, the world saw the rise of the great herring and other fisheries in the Atlantic off Western Europe and the rapid increase in agricultural production in Central Europe. During the colonial period in North America also, fishing and farming marched along at comparable rates. But in more recent times, especially since the middle of the nineteenth century, agriculture in North America has far outdistanced the fishery industry. In general, this has also been true throughout the rest of the world. As long as more land could be brought into production, less and less consideration was given to the sea as a source of food. Recently, however, the trend has reversed, and greater attention is being given to exploring fishery resources and tapping their vast stores of animal protein food. If this trend continues at its present rate, the seven seas will be combed for food fish as they were for whales in the first half of the nineteenth century by the ships from Nantucket and New Bedford.

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* This article is based on "La pesca y las industrias pesqueras en el Perú," a report of the United States Fishery Mission to Peru in 1941, by Reginald H. Fiedler, chief of the mission and economist, Norman D. Jarvis, technologist, and Milton J. Lobell, fishery engineer, translated by E. C. Evans, published by the Compañía Administradora del Guano, Lima, Peru, 1943. The mission was sent under the auspices of the U. S. Department of State and Department of the Interior at the request of the Peruvian government and with the cooperation of the Peruvian Fishery Commission.

The Spanish version of the report is a volume of 371 pages, comprising an introduction and three parts. Part I describes the fish species, with a list of fish names, Peruvian, English, scientific; methods of fishing; the preparing and marketing of the product, with full analytical tables of the catch; fishermen and ports. Part II describes the exploratory voyages of the mission and its technical studies. Part III presents recommendations for advancement of the industry.

For the location of places mentioned see the sheets of the American Geographical Society's Map of Hispanic America, 1 : 1,000,000. For a general map of Peru, 1 : 14,500,000, see p. 2.

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The peoples of many maritime countries that heretofore have depended primarily on agriculture for food are now looking to the sea. Oceanographic and climatic data are being catalogued to determine where and when conditions are most favorable for fishing. Marine resources are being explored to learn which aquatic species are found in sufficient abundance to warrant a commercial fishing industry. Fishing methods are being intensified or modernized to increase efficiency and reduce costs. And more sanitary processing and distribution methods are being practiced to reach new markets.

In line with this trend, Peru has taken an active interest in the development and expansion of its fishing industry. As a part of its program for creating better living conditions the government is seeking to improve the diet of the people by making lower-priced protein foods available, thus cutting down the consumption of vegetable starches. In carrying out this program the government requested the assistance of fishery investigators from the United States government, and it was the good fortune of the writer to be detailed as chief of the mission.

Geography of the Country

Discussion of the fisheries, as of any other of the resources, must begin with the reminder that Peru is three countries in one—a narrow coastal region, the sierra or mountain region, and the montaña or tropical jungle. We are here concerned mainly with the coastal region and the waters offshore.

The arid coastal strip is intersected by a number of rivers, fed by the rains and melting snows in the mountains. From December to March the streams are in flood; by August most of them are lost before reaching the coast. Even in the wet season many of them do not reach the sea, because their headwaters are drawn off for irrigating the valleys. Because of these conditions, anadromous species of fish are lacking. However, in the lower reaches and estuaries of some of the streams that do reach the sea, a freshwater shrimp is taken in cigar-shaped, wicker fyke nets. This crustacean, known as the *camarón de río*, is a highly prized delicacy. Also, at flood times, the drumfish—*robalo*, *corbina*, and other species—congregates at the mouths of rivers, and large catches are made.

The Continental Shelf and the Fisheries

In common with the fisheries in other parts of the world, those off Peru are critically bound to the continental shelf and the oceanographic conditions that prevail thereon. Most of the world's fishing is done in waters less than 100 fathoms deep,[1] where plankton thrives well and provides an abundant source of fish food, and temperature and light are favorable for growth and reproduction. In general, the relative productive capacity of a marine locality can be estimated from the amount of bottom within the 100-fathom contour.

The continental shelf off Peru is about 5 nautical miles wide at Falsa Punta, in the north; at Punta Pescadores, Punta Islay, and Ilo, in the south, it is probably not more than 2 or 3 miles wide. From Cabo Blanco to Falsa Punta the line is 5 to 25 miles offshore. From Falsa Punta to Punta Bermejo the extent of shallow water increases and the distance offshore of the 100-fathom curve ranges from about 5 to 70 miles. From Punta Bermejo to Punta Salinillo the distance ranges from 10 to 40 miles, and from Punta Salinillo to Punta de Sama from 2 to 25 miles. The total calculated area of bottom within the 100-fathom curve for the whole coast is about 26,800 square nautical miles, or about 19 square nautical miles for each mile of the 1400 miles of coast line. This is a contrast with the area of the fishing banks in the western North Atlantic between Cape Cod and the east edge of Newfoundland, which cover about 70,000 square miles and yield annually more than a billion pounds of cod alone. More bottom area within the 100-fathom curve is found in the section of the Peruvian coast north of Callao than in the section south of Callao, and it is along this strip that most of the fishing is carried on.

A number of islands lie within or just on the 100-fathom curve. From north to south the most important are Lobos de Tierra, Lobos de Afuera, Macabi, Guañape, Chao, Isla de La Viuda, Corcovado, Santa, Blanca, Ferrol, Tortuga, Huaura (including Mazorca and Pelado), Hormigas de Tierra, Pescadores, Hormigas de Afuera, San Lorenzo, Pachacamac, Asia, Chincha, Las Ballestas, Sangallán, Las Viejas, and Santa Rosa. South of Santa Rosa (about 14° 20′ S.) there are only a few islands, mostly small, isolated rocks close to shore.

In addition to their valuable guano deposits, these islands are important to the fisheries because many species of fish are found around them, in greater abundance than in the more open waters. Moreover, the islands afford shelter to small fishing boats.

[1] R. H. Fiedler: Fisheries of North America: With Special Reference to the United States, *Geogr. Rev.*, Vol. 30, 1940, pp. 201–214.

Oceanographic and Climatic Conditions

Flowing off the coast of Peru is the cool Peru Coastal Current. Immediately inshore the temperature of the water is normally 14° to 16° C. and the color dark green. The surface temperature rises gradually seaward, so that at a distance of 20 miles it may be 17° to 18° C.; at 50 miles it may be 20° to 21° C.; at 100 miles, 23° to 25° C. The color of the water has now become a clear aquamarine.[2]

The current carries with it an abundance of nutrient salts and has many characteristics conducive to the production and growth of plankton. At times large areas of the ocean surface are colored red, orange, yellow, or brown by enormous concentrations of plankton, and then vast schools of anchovies, skipjacks, dolphins, and other species of fish are not an uncommon sight. During one voyage of the *Pacific Queen*, the exploring vessel of the fishery mission, eleven schools of skipjack (*Katsuwonus pelamis*) were sighted at one time just off the port of Paita. The existence of important fisheries for whales and sea lions off Peru also is due to the richness of these waters in plankton and other food.

The general uniformity of conditions in the current varies, however, from place to place and from time to time. The presence of wedges or tongues of warmer water has been pointed out by oceanographers,[3] and such tongues were located by the mission at a number of points along the coast—one each near Mollendo, the Paracas Peninsula, Mazorca Island, and Salaverry. A trip from the Paracas region, northwest from the Chincha Islands, affords an illustration:

> At 933 [log of the *Pacific Queen*] the surface-temperature at Chincha Island Norte was 15.4°. At 1,100, about 13 miles northwest of Chincha, it was 16.2°. Just before 1,200, the water started to change to a blueish tinge, and at 1,200 the temperature was 17.2°. Just after 1,200, tuna and skipjack started to hit, and the water gradually took on an ultramarine color. At 1,245, the temperature was 17.8°, at 1,315 it was 18.0°—and here the water was definitely blue.
>
> At 1,400 the temperature had dropped to 17.8°. It then dropped rapidly, until at 1,630 it was 16.0°. The last tuna was taken at 1,500 in a temperature between 16.9° and 17.0°. The water at 16.0° had shifted back to a greenish color. From 1,630 on, the temperature rose gradually to 1,800 when it was 16.6°, then rapidly to 17.2°, when several tuna were again taken. At 1,900 the temperature was 17.4°, and at 2,000 it was 18.0°.[4]

Briefly, the significance of the warm-water tongues is that many of the important species in the Peruvian fisheries are warm-water forms. This applies especially to tuna and skipjack, but also more or less to flying fish, bonito, etc. These and others are prevailingly characteristic of the outlying tropical Pacific in the latitudes under discussion. The invasion of the cool coastal water by the warm swirls brings such fish within easy range of boatmen from the fishing settlements. Moreover, convergence lines along which temperature is the principal controlling factor in the relative density of the ocean water on each side always seem to be favorable feeding grounds for marine organisms. It is at such places that fish can often be caught in greatest abundance.

The warm countercurrent, El Niño, flowing southward, displaces the northern end of the Peru Current for a time in the southern summer. Periodically the intensity of the warm current is greatly increased, and its effects are felt far south; in 1925 it was reported as far as Pisco. The sudden change in temperature and associated conditions creates a profound disturbance to marine life; species normal to the cool waters migrate or die. At such times the beaches are littered with enormous quantities of fish, crustaceans, mollusks, and other aquatic animals. The extraordinary phenomena of 1925 have been described in the *Geographical Review* by Robert Cushman Murphy.[5]

An occurrence of the *aguaje*, as this "sea sickness" is called, apparently took place in the waters near Tortuga Bay in 1941.[6] On January 25, when members of our mission visited there, millions of dead fish were floating in the bay and had been cast up on the beach (Fig. 9)—mostly anchovies, though large numbers of sharks, flounders, eels, blennies, rockfish, drum-

[2] M. J. Lobell: Some Observations on the Peruvian Coastal Current, *Amer. Geophys. Union Trans. of 1942*, Part 2, Washington, 1942, pp. 332–336; reference on pp. 332–333. See also the publications listed in the bibliography and R. C. Murphy: The Oceanography of the Peruvian Littoral with Reference to the Abundance and Distribution of Marine Life, *Geogr. Rev.*, Vol. 13, 1923, pp. 64–85. An up-to-date résumé is given in H. U. Sverdrup, M. W. Johnson, and R. H. Fleming: The Oceans: Their Physics, Chemistry, and General Biology, New York, 1942, pp. 701–706.

[3] R. C. Murphy: Notes on the Findings of the "William Scoresby" in the Peru Coastal Current, *Geogr. Rev.*, Vol. 27, 1937, pp. 295–300; E. H. Schweigger: La corriente peruana de Humboldt y el verano de 1939, *Bol. Soc. Geogr. de Lima*, Vol. 56, 1939, pp. 178–190 (extracts are translated in the *Hydrogr. Rev.*, Vol. 17, No. 1, 1940, pp. 196–199); *idem:* Studies of the Peru Coastal Current with Reference to the Extraordinary Summer of 1939, *Proc. Sixth Pacific Sci. Congr., California, 1939*, Vol. 3, Berkeley and Los Angeles, 1940, pp. 177–195.

[4] Lobell, *op. cit.*, pp. 335–336.

[5] Oceanic and Climatic Phenomena along the West Coast of South America during 1925, *Geogr. Rev.*, Vol. 16, 1926, pp. 26–54; *idem:* Conservation and Scientific Forecast, *Science*, Vol. 93 (N.S.), 1941, pp. 603–609. For a graphic description of the phenomena in 1939–1940 see William Vogt: Una depresión ecológica en la costa peruana, *Bol. Compañía Administradora del Guano*, Vol. 16, 1940, pp. 307–329.

[6] E. G. Mears: The Callao Painter, *Scientific Monthly*, Vol. 57, 1943, pp. 331–336.

fish, sea bass, herring, guitarfish, crabs, clams, and octopuses were identified.

This phenomenon has a serious effect on the guano birds, which feed on anchovies and other fish. They die of starvation or of disease brought on by the lack of food, and at times the bodies of dead birds strew the beaches. The adult birds leave their nesting place in search of food, often causing the young to perish.

The climate of Peru is markedly affected by the Andean topography and by oceanic influences. The coastal zone is free from extreme heat and cold. The average air temperature is about 70° F., the range from about 55° to 90°. From May to October the sky is often obscured by low-hanging mists or clouds. From November to April, the summer season, the hottest weather occurs, and skies are usually clear.

Thus, with practically no storms, with equable and comfortable weather for working, and with favorable sailing winds, the Peruvian sea fisherman enjoys certain advantages for the pursuit of his occupation.

Harbors and Ports

The situation in regard to harbors and ports is not so favorable. Peru has only a few good harbors. Many of the ports are on open roadsteads. At some of these, embarkation has been made easier by long steel piers built beyond the breakers. At others, however, it is necessary for boats to pass through the surf and be hauled up on the beach.

The larger bays from north to south are Talara, Paita, Sechura, Chimbote, Samanco, Los Chinos, Casma, Salinas, Ancón, Callao, Paracas, Independencia, San Nicolás, San Juan, Matarani, and the Ilo Roads. There are also smaller coves and roadsteads. In general, these bays offer fair shelter for small boats, but local conditions, such as high winds, rocks, shallow water, heavy swells, and poor harbor facilities, often make them less usable. Shelter can usually be found for a small boat, but care must always be taken when seeking anchorage.

Commercial fishing is carried on from 36 ports along the coast. From north to south these are: Pizarro, Zorritos, Máncora, Cabo Blanco, Lobitos, Talara, Negritos, Paita, Sechura, San José, Pimentel, Santa Rosa, Eten, Pacasmayo, Chicama, Huanchaco, Salaverry, Chimbote, Samanco, Casma, Huarmey, Supe, Carquín, Huacho, Chancay, Ancón, Callao, Pucusana, Cerro Azul, Tambo de Mora, Pisco, Lomas, Chala, Atico, Mollendo, and Ilo. About 26 million pounds of fishery products were landed at these ports in 1940.

Callao was the most important, with landings in 1940 of 6.7 million pounds, or about 26 per cent of the total catch. Pisco was second, with landings of 2.9 million pounds, or 11 per cent of the total; Sechura was third, with 2.6 million pounds, or 10 per cent; and Pimentel fourth, with

Fig. 1—The *caballito*, a precolonial type of fishing craft, still in effective use in Peru.

2.3 million pounds, or 9 per cent. Thus, four of the 36 ports furnished more than half the total landings in 1940.

Callao and Pisco owe their importance as fishing centers to their nearness to both the most productive fishing areas and the largest population centers. Sechura and Pimentel owe their position to the large catches of mackerel, sea bass, and dogfish made near by, a large part of which is salted and marketed in the interior or at other points along the coast as far south as Callao.

The lack of good harbors may tend to concentrate future large-scale fishing enterprises at these points, a circumstance not altogether desirable as regards distance the more productive fishing grounds. However, a few well organized fishing ports, strategically located along the coast at points where adequate facilities are available for handling large quantities of fish and for icing, freezing, curing, or canning them for market might be more economical than less efficient facilities scattered over the long coast.

Variety in the Commercial Catch

Because of the belt of cold water off the Peruvian coast, the normal inshore fish fauna is definitely subtropical or temperate. During abnormal times, however, such as during occurrences of El Niño, the fauna inshore

Fig. 2—Rows of *caballitos* drying on the beach present a grotesque appearance.

is tropical, as it is regularly in the warmer waters offshore and in the Gulf of Guayaquil.

It has been said that the Peruvian fish fauna resembles somewhat that of the Mediterranean because of the mingling of tropical and temperate species, but the closest affinity is with that of California and Lower California, which has a number of related if not identical forms. Yellow-fin tuna, skipjacks, dolphins, and roosterfish are among the species found in both places.

In the statistical records of the catch for 1940, 74 species were named; it is believed, however, that many other species were taken in small quantities and classed under the general heading of "miscellaneous," since some 225 species from these waters have been described.

Of most importance in volume was bonito (*Sarda chilensis*), with landings of about 5.9 million pounds, or 22 per cent of the total catch; mackerel, *caballa* (*Scomber japonicus*), was second, with a catch of about 4.5 million

pounds, or 16 per cent; sharks, reported under the names of *tollo* and *cazón*, with landings of about 2.7 million pounds, made up about 10 per cent. Other species among the first ten were sea bass, *cabrilla* (*Paralabrax* sp.); the drumfish *lorna* (*Sciaena deliciosa*), *corbina* (*S. gilberti*), and *robalo* (*S.*

Fig. 3—A popular and solid type of fishing craft is the *bote*.

starksi), and *suco* (*Polyclemus peruanus*); and whitefish, *peje-blanco* (*Caulolatitus* sp.). These ten species amounted to about three-fourths of the entire catch.

Fresh fish of some kind are available in Peru throughout every month of the year. Some seasonal species may be landed in greater quantities during the winter; others are most abundant during the summer. Furthermore, examination of the records of the landings at the various ports showed that certain species may be landed at the ports in the north during one period of the year and at the ports in the south during the other period. The landings by months in 1940 ranged from 1.5 to 3 million pounds.

Statistics on the landings of shellfish in 1940 were not complete. However, there is evidence to indicate that shellfishery is an important industry in some areas along the coast. According to records from Puerto Pizarro, Huacho, Atico, Mollendo, and Ilo, the catch of shellfish in 1940 amounted to about 450,000 pounds, made up of *langostinas* (*Peneus* sp.), *chanques*, *conchas*, *mangleras*, *barquillos*, *horas*, *erizos*, and *señoritas* (*Pecten* sp.).

FIG. 8—Boats from Sechura unloading fish in the harbor of Paita.

logs. *Figueroa* and *huachapeli* woods are preferred. These craft may be propelled by paddles or by a square sail with a loose foot and a yard at the top.

After the influx of Spanish and Italian fishermen in the nineteenth century, boat design reflected the types common in the homelands of these colonists. These types, however, do not have a deep keel or a centerboard and therefore cannot sail very close to the wind.

The most useful and popular craft introduced by the European fishermen, and seen at most of the larger ports, is the trim *falúa*, the felucca of Mediterranean origin. They are double-enders, pointed at each end, and may be entirely or partly decked. The bottom is rounded, and the hull carvel-built. An average length is 18 feet, beam 6 feet, and depth 3 feet. Amidships is a hatch (*escotilla*) about 3 by 9 feet. In the stern is a smaller hatch (*escotilla de popa*), leading to a small hold called a *salón*, which serves as storage space for fishing equipment and fish.

The hold is completely enclosed when the covers are placed on the hatches. Bedding, clothing, and other articles are placed in the little forepeak; rice, beans, coffee, wine, and cooking utensils are stowed in the spaces under the side decks. When the boats remain out overnight, the fishermen sleep forward under the bow. Cooking is done on a brazier placed on the bottom of the hold, with charcoal or wood for fuel.

The rig of a falúa is a lateen sail of canvas attached to a yard or *antena* hoisted obliquely to the mast with the forward end down at the bow. Because these boats lack a centerboard or a deep keel, it is often necessary to propel them with oars. The rower stands in the escotilla in the stern, facing forward. These craft are very successful in working bonito gill nets (*boniteras*) and dredges (*rastras*) for shellfish.

FIG. 9—Million of dead fish in Tortuga Bay—the effect of "*El Niño*."

A fleet of brightly colored faluas, full sail to the wind, skimming out to the fishing grounds or returning to port in the sunset, is a picturesque sight.

Another popular and solid type of sailing craft is the *bote*, which we found at its best at Sechura, San José, Talara, Paita, and Máncora. These average about 24 feet in length, with a beam of 8 feet and a draft of 2 to 3 feet. They have a square stern and are not decked, except perhaps a very little at the bow. They also lack a deep keel or a centerboard.

The rig of the botes varies from place to place. At Supe, for example, a square sail with a loose foot and an upper yard is used; at Pacasmayo the mainsail is triangular, sometimes augmented with a small jib; at Pimentel the mainsail is square, rigged fore and aft on a boom and gaff, with the gaff fastened perpendicularly to the mast. At other ports other variations occur.

The carrying capacity of these craft is about 6 tons, according to the size. The crew consists of 4 to 7 men. Their sleeping quarters are in the stern, and charcoal stoves are set up forward for cooking meals, which usually consist of rice, beans, and fish.

Botes are used for fishing with gill nets, hand lines, and trawl lines and for trolling (*a la carrera*). The larger ones can fish at considerable distances from shore, and on some voyages they may be away from the home port for as long a time as a month. The fish caught on these trips are salted aboard the boat.

Zapatos (so called because they resemble a shoe) were seen in Huarmey and a few other places. These craft are snub-nosed fore and aft, have no keel, and are propelled by oars. They average about 18 feet in length, 6 feet in width, and 3 feet in depth. Since they are not very seaworthy, they are used mainly for handling haul-seine nets, which are worked from the beach.

Other types of fishing craft are *chalanas*, skiffs, rowboats, and a few

motorboats. These last include some launches, most of which are motorized sailboats, and towboats (*remolcadores*), used for fishing when they are not employed as lighters for carrying passengers and freight. Three modern purse-seine fishing boats, imported from the United States, have been added to the fleet. One of these is the *Pacific Queen*, brought to Peru for the exploratory fishing by the fishery mission and at the conclusion of the investigations purchased by the Peruvian government.

FIG. 10—Anchovies drying in the sun at Carquín. (M. J. Lobell.)

In all, there were about 2400 fishing boats of various types in the Peruvian fisheries in 1941. Only 87 were motorized. Sailboats numbered 1285, more than half of the total. There were 720 chalanas, 127 zapatos, and about 90 caballitos. The others were miscellaneous small craft.

The greatest number of craft, 1373, operated in the central section of the coast between Supe and Pisco, where fishing is most highly developed. Of these, 703 were from Callao, 124 from Ancón, and 126 from Pisco. Between Puerto Pizarro and Casma, in the northern section, 941 boats operated, 220 of them from the port of Sechura. Between Puerto Lomas and Ilo, in the southern section, only 90 boats were in operation.

FISHING GEAR

The gill net (*red* or *red derecha*) is probably the most widespread and versatile piece of fishing gear used in Peru. The mesh varies according to the kind of fish to be taken. Usually the nets are handmade of cotton thread or hemp cord, with floats of cork or gourds and sinkers of lead or stones. They are used along the beach or offshore, set on the surface or on the bottom, sometimes in the shape of the letter *S* or a figure 6. These nets are used for catching bonitos, mullets, drumfish, silversides, sharks, and others.

Although the trammel net (*trasmallo* or *red de tres paños*), made of cotton twine, is a relatively recent innovation introduced by European fishermen, it is now used along the entire coast of Peru. As the Spanish name suggests, the nets consist of three layers of netting attached to single head

and foot lines, the middle layer of smaller mesh than the two outer ones.

They are worked as set or drift nets. Fish attempting to pass through the large mesh of either outer layer strike the smaller mesh of the middle

FIG. 11—The beach at Carquín. Overhauling the *chinchorro*. (M. J. Lobell.)

layer and push it through the other outer one, thus forming a pocket in which they are trapped. These nets catch the same species as the gill nets.

One of the most efficient pieces of gear is the haul seine (*chinchorro*), worked from suitable beaches. The net is paid out from the stern of a boat as it leaves the shore and travels in a semicircle back again. It is then hauled onto the beach by lines attached to the ends of the wings, trapping in the pocket thus made any fish between the net and the beach. These nets catch various kinds of littoral species. A modification of this net is used at Carquín to catch anchovies offshore.

Trawl lines (*espineles*) are used to some extent. These consist of a ground line to which short lines with hooks are fastened at intervals of 3 to 6 feet. They are used on the bottom in depths of 20 to 50 fathoms or more and catch, among other species, the *congrio*, cusk eel, considered one of the best Peruvian fishes. Greater use might be made of the trawl line, since it is highly effective in catching bottom species.

Hand lines (*cordeles*) catch a large part of the fish taken in Peruvian waters. They are used on the bottom and near the surface from all types of

craft. Bait consists of small fish, various kinds of shellfish—in fact, any kind of fish available.

Cast nets (*atarrayas*), made of cotton webbing, are used to some extent

FIG. 12—Huanchaco, the home port of some 140 fishermen.

in shallow water alongshore. The net is circular, with a radius of 6 feet or more. The perimeter is heavily weighted with leads, and when the net is cast on the surface, these sink to the bottom, pulling the net down and trapping the fish beneath it. The net is then retrieved by a line, and the fish are captured in the pockets formed in the outer margin. These nets are efficient for catching mullets, flounders, sea bass, and other littoral species.

Doubtless because of the large number of pelagic fish found off Peru, the fishermen are well acquainted with trolling. The equipment usually consists of a heavy cotton line with a jig (*muestra*) of bone or cloth at the end. A piece of sheet lead is used for the jig head, with white or colored rags tied to it. The lines, which are generally tied to the gunwales of the sailboats, are drawn behind as the boats are propelled forward by the wind, and large numbers of drumfish, sawfish, bonitos, tuna, skipjacks, and dolphins are taken in this manner. This piece of gear offers excellent opportunities for improvement, and the catch could be greatly increased by fastening swivels, leaders, trolling springs, and feather jigs in the line and by attaching the line to an outrigger on the boat.

FIG. 13—A fishery products laboratory established at Chicuito on Callao harbor by the Fishery Mission through the cooperation of the Peruvian Fishery Commission. (M. J. Lobell.)

THE FISHERMEN OF PERU

The fishing population of Peru in 1941 numbered 6568, mainly Indians or racial mixtures in which Indian blood predominated. At Callao and a few of the other larger ports there were groups of Italian and Spanish fishermen. Callao, with 1768 fishermen, had 27 per cent of the total; Sechura, 1183, or 18 per cent; San José, 308, or 5 per cent; and Pisco, 267, or 4 per cent. The northern region had 3102 fishermen, or 47 per cent; the central region 3349, or 51 per cent; and the southern region 117, or 2 per cent.

The right to fish in Peruvian waters is reserved to Peruvian fishermen, either native or naturalized, who must be licensed by the port captain. Under the terms of a treaty concluded with Italy in 1878, Italian residents are permitted to engage in the fishing under the same conditions as the Peruvians. Fishing vessels may be owned in whole or in part only by Peruvians by birth or by naturalization and by Italian residents. The port captain has the authority to set the time limits for fishing voyages and the areas where fishing may be carried on. Often, in the interest of safety, the fishermen are not permitted to be absent from port more than 24 hours.

At some of the ports the fishermen have banded into maritime societies known as *gremios*, the purpose of which is to foster the general welfare of

FIG. 14—Important fisheries are conducted in Lake Titicaca, at an altitude of 12,000 feet above sea level.

the fishing industry. Their membership ranges from 15 to more than 1000. In some respects they are akin to the medieval guilds, not least in their religious affiliation. They consider such matters of mutual concern as fishing regulations, port facilities, prices of fishing equipment, and prices of fish.

FRESH-WATER FISHERIES

The interior waters of Peru supply small amounts of a variety of fish. In some localities a sizable proportion of the animal protein of the people is furnished by this source. One of the most important fresh-water fisheries is in Lake Titicaca. Despite the altitude—12,000 feet above sea level—the lake never freezes and is open for navigation and fishing the year round. The species of commercial importance found here are *boga, suche, carache, umanto, mauri,* and *ispi* or *hispe.*

Scattered along the shores of Lake Titicaca are the villages of some 300 fishermen, mostly Indians, who carry on the industry by clans or family groups. Their villages are frequently moved, according to the growth of the many-purpose totora, which they need to build their houses, to make their mats, to use as fuel, and, most important, to build their balsas. There are about 300 balsas in use by Peruvian fishermen on the lake, the largest

FIG. 15—Fishing balsas on Lake Titicaca.

of which are about 12 feet long and 3 feet wide. They are constructed on the general plan of the caballitos, but they are shaped more like a boat, and the bow is not as high out of the water. When fishing, the fishermen ride in the craft.

The fish are caught with bag nets, stop nets, and gigs. The bag nets are towed at or near the surface behind two balsas spaced 6 or 8 feet apart to hold the bag of the net open. Fisherwomen in balsas ahead of the fishing boats splash the water with paddles or sticks and drive the fish into the net. As many as 100 fish, mostly *bogas,* may be caught in a day.

The stop nets are gill nets anchored in the form of traps at locations along the shore. At night by beating the surface of the water the men drive the fish into the nets, where they are gilled in the twine. *Carache, boga,* and *umanto* are caught by this method.

The gig, a tined pole, is used at night to spear fish attracted by torches carried on balsas.

A fish hatchery has been established at Chucuito, a small village near Puno. This is operated by the Peruvian government in cooperation with the government of Bolivia. Eggs for hatching have been supplied from time to time by the United States government.[10] During June and July, 1940, some thirty thousand 2-inch lake-trout fingerlings hatched at the station were planted in Lake Titicaca. At the time our mission visited the hatchery in 1941 it was too early to determine whether the trout would become acclimated to the water conditions in the lake. If the conditions are suitable, however, Titicaca may support a sizable fishery for this important food fish.

We found the hatchery to be soundly planned and administered. In an undertaking of this kind many obstacles have to be overcome, and resourcefulness and good judgment were shown in the adaptation of fish-culture techniques to local conditions.

[10] J. L. Bennett: Fish for the Rivers of Peru, *Foreign Commerce Weekly,* Vol. 11, No. 2, 1943, pp. 10–11 and 36–37.

Fishing for *suche* is carried on in the Laro, Calapuja, and Suches Rivers, not far from Juliaca. The fish are caught at night in large hoop nets operated from balsas. They are attracted by the light of torches and are driven into the net by poles or sticks. An evening's catch would be about 10 fish, averaging about 2 pounds each. The best fishing season is from April to September, when the rivers are low.

FIG. 16—Fish hatchery at Chucuito on Lake Titicaca.

Fishing is carried on in other rivers, especially in the headwaters of the Amazon, in the eastern part of the country.[11] It has been reported that mussel shells are found in practically all the rivers of the Amazon basin in Peru. Some shells were tested in the United States to determine their value for buttons, but they were found to be unsuitable.

HANDLING AND MARKETING THE CATCH

The fresh fish landed at the coastal ports are sold at retail in the central markets, except for shipments to Lima. The retailing is done almost entirely by women, usually the wife of the fisherman or some other member of his family. The markets open very early in the morning, and sales are practically completed by 11 a. m. Sunday is one of the busiest days.

The landing of fish at Callao is probably better organized than at any other port. Here a small pier for the exclusive use of the fishermen has been built into the harbor near the Frigorífico Nacional, a cold-storage warehouse catering to the fishing industry, where fish can be frozen or held in cold rooms in temporary storage. The fishermen landing at Callao sell their catches to dealers located on the pier, who in turn sell to retailers in the market in the Callao-Lima area. This area also receives regular truck shipments of fresh, iced fish from ports as far north as Casma and as far south as Pisco. Some of these are carried on trucks with specially constructed insulated bodies. How different from the courier method of distributing

[11] The importance of fish in the diet of the people of the Amazonian region of Peru is emphasized in C. H. Eigenmann and W. R. Allen: Fishes of Western South America, Lexington, Ky., 1942, p. 24.

fresh fish during the Inca period, when the royal table in Cusco was served with fresh fish, taken a hundred leagues from the capital, in twenty-four hours after it was drawn from the ocean!

Often the fish shipped from distant ports to Lima are handled by *regatones*, or middlemen, who charge a commission to dispose of the fish to the retailers. Regatones also operate in Piura, Chiclayo, and Trujillo, handling salt fish landed by fishermen from Sechura.

The salting and drying of fish in Peru is done by the individual fishermen rather than by firms established for this purpose. Most of the trade is confined to the northern ports. Here, because of the distance from the large population centers, the fishermen cannot reach the largest fresh-fish markets. Excess catches are therefore salted. Also, since the Sechura fishermen make long voyages, they salt the fish caught during the early days of the voyage. The methods of salting are primitive, and the product is preserved for only a short time.

Bonito, sharks, mackerel, sea bass, mullet, and drumfish are among the important species salted. Small quantities of anchovies are dry-salted by spreading them in thin layers on the rocks or on straw mats, scattering salt over them, and leaving them to dry in the sun.

A small amount of fish is frozen. Before the present war this was prepared mainly for the export trade, since the Peruvians were reluctant to purchase this kind of product.

At the time our mission visited Peru in 1941, a small fish-canning industry was located in Callao, Lima, and Pisco. Tuna, bonitos, and sardines were canned. Formerly the packers used handmade cans produced in Peru, but now the cans are mostly machine-made, imported from the United States. During the past year this industry has expanded greatly, and plants at other ports are projected.

The mission conducted many experiments in the salting, drying, smoking, and canning of fishery products at a fishery-products laboratory we established at Chicuito, on Callao harbor, through the cooperation of the Peruvian Fishery Commission. As a result of this work, processing methods adaptable to Peruvian conditions were developed. Opportunities exist for a rather large salt-fish industry, since fish suitable for salting can be taken in abundance, and there are vast salt deposits, some almost pure, along the coast.

Peruvians are fond of all kinds of marine food, and practically every animal and vegetable product found in the waters off the coast serves as

food for some part of the population. The many kinds of fish, sharks, rays, fresh and dried seaweeds, dried flying-fish eggs, chitons, sea anemones, and sea urchins all find their way to the table, for which they are prepared in many appetizing ways. *Caldillo de congrio*, *arroz con pescado*, *arroz con camarones*, *chupe limeño*, *escabeche*, *jalea*, *seviche de conchas*, and *torrejas de pescado* are a few of the well liked fish dishes. Merely to hear these musical names is enough to whet the appetite.

Nevertheless, the 7 million people of Peru consumed in 1940 only about 4.4 pounds (2 kilograms) per capita of fish. This is in marked contrast with an annual per capita consumption of about 13 pounds in the United States, 44 pounds in England and Wales, 12 pounds in Uruguay, 10 pounds in the Argentine Republic, and 8 pounds in Chile.

It is believed that the people of Peru could easily consume five times the present per capita quantity and thus absorb a catch of 140 to 150 million pounds annually. The waters off Peru seem capable of supplying this amount, and also a surplus for the export market.

With only small additions to their equipment, the fishermen of Peru in 1942 landed and marketed three times the catch of 1940. With a moderate amount of additional gear and motorized equipment they should be able to take 150 million pounds or more annually. Modern collecting stations, however, will be needed at the most important ports to process the catch effectively, and more rapid and regular transportation and more modern retail marketing facilities must be created for distributing it. The consuming markets are ready to receive more fish, not only in localities along the seaboard but also in the sierra and the interior.

The Peruvian government realizes that the country's fisheries have large possibilities for increasing the supply of protein food for the people, and it is taking aggressive action to make full use of this great natural resource. In the past year it established a fishery department to give attention to all phases of fish production, processing, and marketing, in accordance with the recommendations of the fishery mission. Cooperation with the United States government in this work has been effected through the Servicio Inter-Americano de la Producción de Alimentos, also formed in 1943.

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